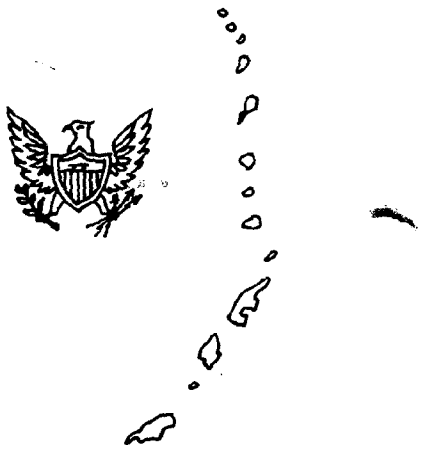
PHYSICAL DEVELOPMENT MASTER PLAN
for the
COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS



Volume V

PAGAN

Prepared for

OFFICE OF
TRANSITION STUDIES AND PLANNING

Prepared by

PACIFIC PLANNING AND DESIGN CONSULTANTS

Chalan Kanoa, Saipan — Tamuning, Guam

January 1978

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FOREWORD

The Physical Development Master Plan for Pagan is based on assumptions proposed in the Socioeconomic Development Plan. The Socioeconomic Plan suggests a program of expenditures during the Plan Period (1978-1985) which will improve the quality and frequency of services to and from the Northern Islands, thereby increasing the standard of living for the inhabitants. The outline of the Foreword follows that of the Master Plan and should readily assist those persons interested in locating specific areas of interest. The Master Plan as developed herein focuses on the Present Plan Period (1978-1985).

POPULATION: (uncertain)

Present population is estimated to be between 37 and 40 persons. The number is variable as many persons who were born and raised on Pagan are now living, working, or going to school in Saipan. Should economic development occur, many of these persons might decide to return. The population is not anticipated to increase dramatically and will probably remain near its present level unless major economic development occurs. During the Plan Period (1978-1985), it is doubtful that the population would ever exceed 200 persons.

ECONOMY:

Future economic growth will certainly require the stimulus of a private or international development project in conjunction with the Northern Mariana Islands Government. Government should remain open to outside suggestions but be cautious of plans requiring significant expenditures of NMI Capital Resources. The possibility of basalt excavations in cooperation with Guam or proposals which include

increased tourism are activities presently recognized with good prospects for development. Proposed geothermal leases of land and the recent proposal for Maug to be utilized for a multi-national fuel storage facility must be viewed with skepticism and be carefully weighed against impacts to the social, political, and natural environment.

LAND USE:

Existing and future development are expected to remain in the vicinity of Bandera-Shomushon. Presently, this area has access to the limited infrastructure improvements available to the Paganese.

A Land Use Plan for the island is presented, and a schematic for the development of the Bandera Homestead Area is also included in the Plan. The proposed Land Use Plan suggests five zones or districts. They include Conservation, Agriculture, Residential-Village, Commercial Industrial, and Hotel-Resort areas.

Planning and funds for implementation should be made available from the Public Land Corporation which is responsible for reconciliating land tenure questions and the Village Homestead Program.

PUBLIC FACILITIES:

During the Plan Period, a new Hill-Burton dispensary and a new school house to replace the existing dilapidated structures will be built. A new community reefer facility is also proposed for the island. The sites for these

facilities have been schematically located on the Village Plan for Bandera.

PUBLIC UTILITIES: Physical Improvements to Public Utilities during the Plan Period are limited to Water, Power, and Communications. Recommendations for sanitation sewerage and solid waste have also been included in the Plan.

Water — Improvements necessary to repair the water supply and distribution system are expensive, and it is suggested that during the short-range Plan Period, the residents continue to rely on individual catchments and storage tanks. The Japanese well north of the airfield should be developed into a community facility.

Power — During the Plan Period, it is recommended that two (2) 20 to 25 KW generators be purchased and installed and that most of the existing distribution lines be replaced.

Sanitary Sewerage — The Plan recommends the continued use of individual sewage disposal systems. It is hoped that with the assistance of Farmers Home Administration and the Village Homestead Program that funds will be made available to construct cesspools or septic tanks, thereby eliminating the need for privies.

Solid Waste — The individual disposal of solid waste is expected to continue during the Plan Period. The Public Health Officer should make certain that disposal methods minimize public health hazards.

Communications — During the Plan Period, communications with Saipan and the other Mariana Islands is expected to improve with increased Field Trip Vessel Service and more frequent Air-Charters. The continued utilization of High Frequency Radio for general Government and emergency communications will be necessary and the need to purchase and install a new radio is envisioned during the Plan Period.

TRANSPORTATION: Inter- and intra-island transportation improvements to air, water, and land facilities are necessary during present and subsequent planning periods.

Air — Necessary improvements to the airport include grading and clearing approach and transitional zones of obstructions. Improvements will be the responsibility of Mariana Islands Airport Authority (MIAA). Presently, MIAA is attempting to have Pagan placed on the NASP (National Air-Space Systems Plan) so as to make Pagan eligible for ADAP (Airport Development Aid Program) funds.

Harbor — Repair of the dock to allow present Field Trip Vessels to dock and unload rather than lighter goods ashore is estimated to cost in excess of $600,000. This would include the reconstruction of 200 feet of medium depth pier. During the Plan Period (1978-1985), continued lightering of goods to shore will be necessary unless a development proposal including the repair of the dock is proposed by outside interests.

Roads	Present vehicle population is but two (2) jeeps, a tractor, and a motorcycle. The maintenance of access to agricultural lands and improvements of roads in the vicinity of the village are envisioned as being necessary during the Plan Period. This will require the transportation of equipment and personnel from Saipan to work on the proposed improvements. Such improvements should be completed in conjunction with the overall plan for the Bandera Village Homestead Area and any proposed improvements to the air field.

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GOALS AND OBJECTIVES

Basic guidelines directing the efforts of the Physical Development Master Plan for Pagan were provided by the Office of Transition Studies and Planning. Proposed guidelines were as follows:

* Evolve a Physical Development Master Plan for Pagan which will enhance and improve the standard of living for this small island community.

* Recognize natural environmental constraints such as slopes, soils, and water in the location of future development and preserve to the maximum extent possible the scenic and natural character of the island.

* Develop a land use plan which can be used as a guide to provide for orderly growth during the Present Plan Period (1978-1985) and subsequent plan periods.

* Promote and provide for the increasing economic independence for the island of Pagan.

* Develop a plan in conjunction with the Socioeconomic Development Plan for the Northern Mariana Islands which will improve the level and quality of services to the northern islands.

NATURAL SETTING FOR PLANNING

GEOGRAPHY

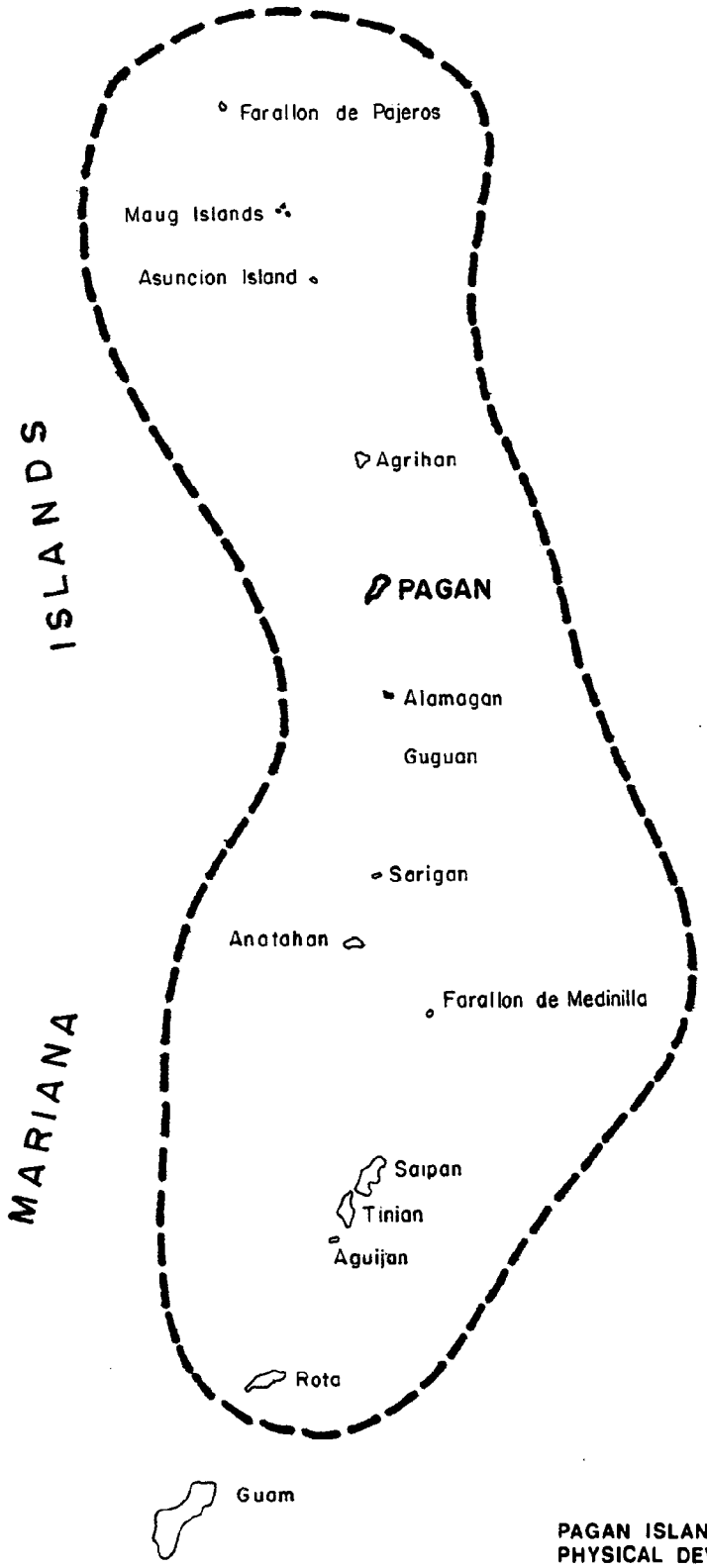
Pagan is located in the Western Pacific Ocean between latitudes 18°01' N to 18°11' N and between longitude 145°42' E and 145° 49' E. Pagan is located 203 nautical miles north of Saipan and 288 nautical miles north-northeast of Guam. The larger continental island groups of Japan, Ryukyus, Philippines and New Guinea are all within 1100 to 1600 nautical miles of Pagan extending in a north-south arc.

Pagan is the middle and largest island of the northern island chain. The island is approximately 10 miles long and ranges in width from one half to four miles. The land area is approximately 18.5 square miles (11,795 acres).

GEOLOGY

The Mariana Islands are the exposed crests of mountains on the easternmost ridge separating the basins of the Philippine Sea and the Pacific Ocean. The Mariana Ridge appears to have two longitudinal crests, the northern island chain consisting of the islands extending from Anatahan to Farallon de Pajaros (Uracas), and the presumed older chain extending from Saipan to Guam.

The northern island chain consists of the summits and upper portions of large volcanoes that rise from depths of as much as 6,000 feet. Frequent eruptions have been recorded within the past few hundred years. Farallon de Pajaros at the north end of the group is one of the most active volcanoes of the western Pacific. Volcanoes on Pagan, Asuncion, Agrihan, and Guguan have erupted since 1900. Many craters, original volcanic slopes, and relatively fresh lava flows are preserved.



PAGAN ISLAND
PHYSICAL DEVELOPMENT MASTER PLAN

VICINITY MAP

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The present volcanoes of Pagan, like those of the other northern Mariana Islands, are geologically young and therefore retain much of their original form and structure. Indicators of continuing activity include hot springs, steam vents and, as recent as 1925, eruptions. The rock types, shoreline features, and thin soils are analogous to those of other islands of the northern chain.

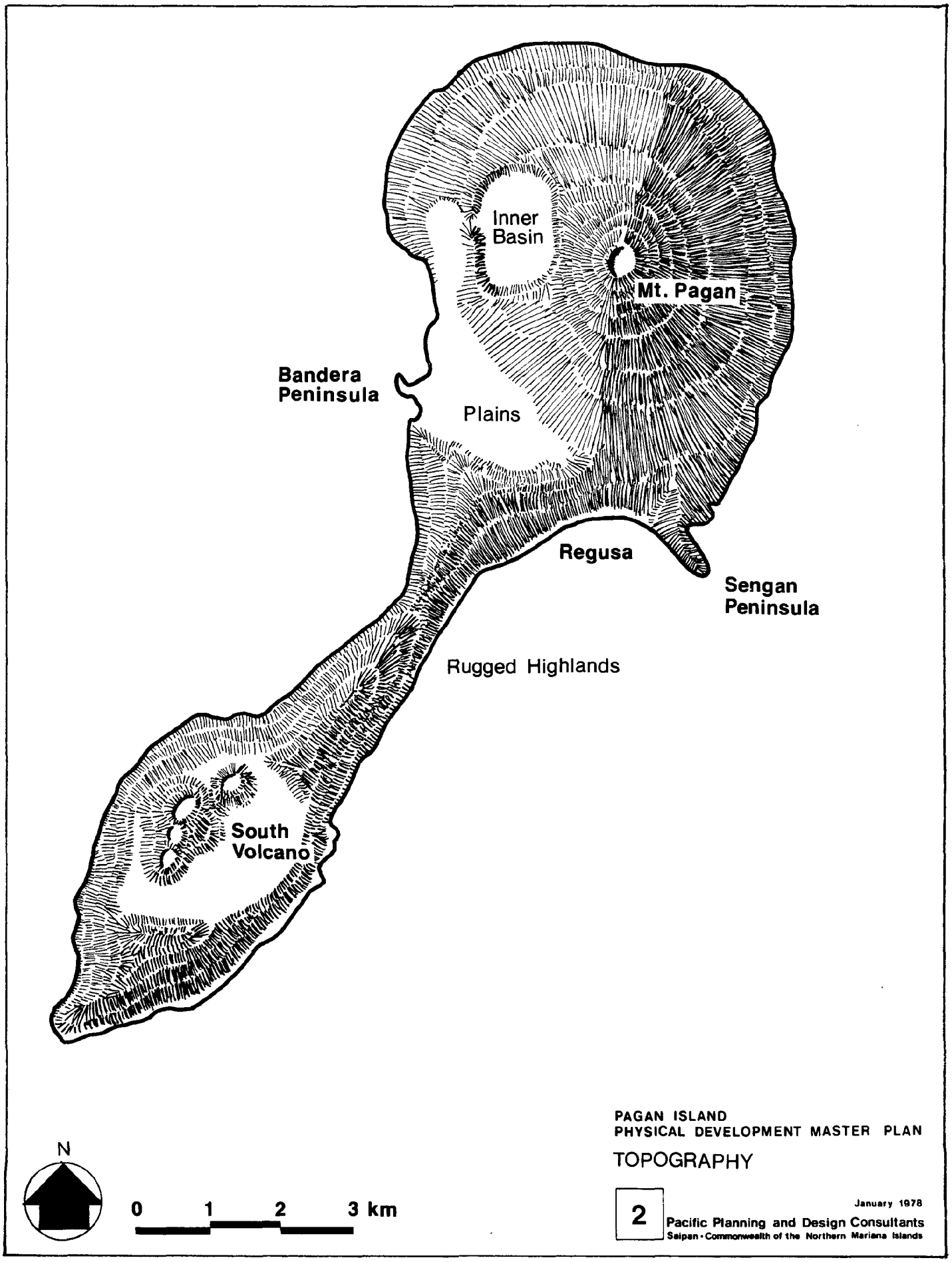
TOPOGRAPHY

About three-quarters of Pagan consists of barren lava fields and mountaineous terrain rising to nearly 2,000 feet. The northern part of the island is dominated by Mt. Pagan, the southern part is essentially a volcanic mountain. The two volcanoes are narrow isthmus connected by a high steep ridge.

The two mountainous regions are semi-active volcanoes. South Volcano with four separate cratered cones is near the southern end of the South Pagan Peninsula and attains a maximum elevation of 1899 ft. Mt. Pagan is centrally located on the main body of the island and rises to 1870 ft. Other significant topographic features include the two lakes, Inner Lake (Lagunan Sanhalom) and Outer Lake (Lagona Lake), the Plains and Basin floors and cliffs (see Plate 2).

Volcanoes

Geologic history indicates that in ancient times Mt. Pagan was probably a cone shaped volcano reaching about 4,000 feet above sea level. At some time long past, this ancient mountain collapsed into itself forming a deep crater or caldera encircled by a rim of cliffs rising from one hundred to 800 feet above sea level. Parts of this rim of cliffs still remain, the most evident being the high cliff separating the plains from the rugged isthmus.



PAGAN ISLAND
PHYSICAL DEVELOPMENT MASTER PLAN

TOPOGRAPHY

2

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Since the collapse of ancient Mt. Pagan and the formation of the caldera there appears to have been considerable volcanic activity which has resulted in the filling in of much of the caldera with volcanic ash, lava flows and the formation of the present mountain.

Mt. Pagan is a fairly symmetrical cone shaped volcano, dominating the terrain of northern Pagan. Mt. Pagan proper, as separated from the surrounding lava fields and dissected ridges, begins at an elevation of about 500-feet and rises to 1870 feet.

South Volcano rises on the west side of a semicircular plateau separating uplands at the south end of the island from those of the Isthmus. The summit of the volcano is irregular and has four craters. Its west and northwest sides slope directly to the ocean. The other two sides are rough lava fields forming the plateau. The lava fields and the uplands to the south are bounded along the coasts by steep slopes with numerous high cliffs.

Lava fields comprise the eastern half of the northern part of the island beyond the flanks of Mt. Pagan. These areas are like plains in general description but they have irregular, extremely rough surfaces of volcanic rock. Much of this area lacks vegetation.

There are no streams on the island and little or no surface runoff even during moderately heavy rains, however, a well defined valley system exists. Streams developed during downpours or soon after volcanic eruptions probably formed most valleys. The absence of streams and significant runoff during normal and heavy rains can be attributed to dense vegetation and to high infiltration rates into the volcanic soil.

Rugged Highlands

The most extensive area of highlands is the isthmus, a mountainous ridge with a maximum elevation of about 1900 feet. Slopes are generally greater than 65 percent. The crestline of the ridge is consistently above 1,000 feet (300 m.) in elevation. Throughout the Rugged Highlands the surface is rough with numerous exposures of bare rock. Many steep slopes and knife edge ridges have been produced on the upper slopes by slides and associated gullying. Access is extremely difficult.

Sengan Peninsula and Bandera Peninsula are smaller areas exhibiting characteristic rugged topography.

Plains and Basin Floors

The southern and western half of North Pagan is comprised of gently to moderately sloping plains and basins. The largest area of notably flat land is the present airstrip which is about 3,000 feet long and 1,000 feet wide. Smaller areas of nearly flat land occur north and northwest of the air field on Bandera Peninsula and on the floors of the two lake basins.

Slopes are generally less than 4 percent in most of the plains areas south of the lake basins and less than 15 percent within the basins. The basins and plains are volcanic tuff and alluvium except for small areas of rough lava.

CLIMATE

Pagan has a tropical maritime climate with a dry or winter season from November to June and a wet or summer season from July to October. Humidity, temperature and pressure vary only slightly throughout the year. Rainfall and wind conditions vary markedly and it is these variations that subdivide the year into the wet and dry seasons.

Rainfall

The annual rainfall appears to average between 70 and 80 inches and is probably in the vicinity of 75 inches. Most of the precipitation occurs during showers of short duration. The dry winter and wet summer distribution of rainfall is quite pronounced. April is the driest month and September the wettest.

Wind

Winds of from 5 to 10 miles per hour are normal with some increase of velocities toward evening. Short duration winds in the 20 to 30 mile per hour class often accompany rain showers. Surface winds are prevailing easterly throughout the year but there are definite seasonal differences. From December to March winds blow predominantly from the northeast. In August and September winds characteristically blow from the southeast, south, and southwest.

Air Temperature

Temperatures are uniformly warm throughout the year reflecting the nearness to the equator. Lowest temperatures occur in January and February. Average annual temperatures are believed to range between 81 and 85 degrees. The normal minimum are probably about 70 degrees F and extremes may be close to 60 degrees F. The highest temperatures generally occur in June but may be as early as April or late as September. Extreme maxima recorded was 96.6 degrees in 1954.

Tropical Storm and Typhoons

Major tropical disturbances with cyclonic winds of 33-65 knots are most frequent during the rainy season although they are by no means restricted to that part of the year. Typhoons with winds in excess of 65 knots have been recorded on Pagan.

Typhoon Jean, hit the island in April 1968 causing extensive damage to crops and property. Most recently, in May of 1976 Typhoon Pamela caused extensive damage to the southern Marianas and minor damages to the northern islands of Pagan and Agrihan.

SOILS

Surface weathering of recent lava flows and ash covering most of Pagan is very shallow or absent; soils where present, are immature. Advanced weathering of soils are confined to rocks which have been subjected to long periods of exposure.

Soils are thin and largely confined to gentle slopes. The maximum depth is seldom more than two (2) feet. Soils of this depth are found in the inner basin, the vicinity of the village, and Regusa area about 4 miles east of the village. Over the rest of the island soils seldom reach a depth of greater than 6 inches. Many places on Pagan have very little or no soil material present.

Soil properties and soil characteristics except for depth appear to be the same throughout the area. Soil appears to be well drained, moderately fine, silty loam, very friable when moist. The color of the "A" horizon or top soil is dark brown. In the deepest deposits the top soil is 8 to 10 inches deep and the subsoil is 20 to 30 inches deep. The color of the subsoil is yellow, to yellowish brown. This is underlain by volcanic deposits. Areas with deeper soil profile are the flat area in the inner basin, the flat area in the Laguna Lake Basin, Malas, the village area and the Regusa areas.

The flat area in the vicinity of the village has been severely disturbed. Man made features such as, tank traps, foxholes, bomb craters, concrete slabs and the present airstrip are the principle reasons people are not farming this land.

WATER RESOURCES

Water resources as discussed herein include both surface water and ground water bodies. Surface water bodies on Pagan consists of the two lakes and numerous cisterns. Ground water bodies including water in perched or centered water bodies or ground water in a basal lens.

Surface Water

Surface water sources include Inner Lake and Laguna Lake. Both lakes are mineralized and not considered to be potable. Inner Lake, approximately 43 acres in size, exhibits chloride content of between 2,000 and 3,000 and total dissolved solids of about 4,500. Studies in 1954 indicated salinities were highest near the warm springs possibly indicating that the hot spring water was being heated at depth and moving upward through vents and dykes. If the activity of the hot springs has decreased significantly, water quality may have improved with continued precipitation and flow of fresh water into the Inner Lake. Water quality and chlorides were observed to improve during the rainy season. The lake has a maximum depth of about 75 feet, attaining a depth of sixty-five (65) to seventy (70) feet below sea level. Most probably mixing of saline water occurs through vents, faults and the bedrock substrate. Generally the water is unsuitable for most uses.

Laguna Lake (approximately 40 acres in size) is elongated in a north-south direction and has a maximum depth of about 65 feet. The upper surface of the lake averages about 1/2 foot above mean sea level. A bar 30 feet above sea level composed of marine tuffs and basaltic sands separates the ocean from the lake. Storm driven waves occasionally over top the bar.

Waters of the lake exhibit chloride contents of approximately 7,000 ppm and total dissolved solids of about 16,000 ppm. Lake water is generally unsuitable for most uses. There is also concern of biological contamination of the waters.

Other surface water bodies consists of cisterns, seven of which were still in use during recent field investigations, and a small ponding basin contained in the abandoned water catchment system constructed by the SeaBee Civic Action Team in the early 1970's on the flanks of Mt. Pagan.

Ground Water

Most of the infiltrating rain water percolates rapidly downward to the upper surface of the large basal fresh water body. The lighter fresh water floats on the heavier salt water allowing the waters to maintain their individual identities. With addition of water from above (rainwater) and the loss of water by lateral underflow to the sea all water in the lens is in motion and a dynamic rather than static equilibrium is established.

Only in the northern caldera is the lens developed to the extent that ground waters are considered capable of producing potable water. However, even in the northern caldera, convection currents have destroyed portions of the lens such that the development of freshwater resources is questionable.

Evaluation

Good quality water may be available from well waters in the plains surrounding Mt. Pagan; however, care in well development is necessary. Low withdrawal rates will probably be necessary, and pumping tests must be performed on each well drilled. Basal tunnels at sea level or maui type wells will probably sustain the heaviest drafts.

No large high level ground water bodies of ground water have been identified although the occurence of small bodies of water may occur at depth on South Volcano and Mt. Pagan and within the several calderas.

The best and most reliable source of good quality water will continue to be rain catchments.

FAUNA

Pagan island lacks endemic mammals. The only indigeneous or native mammal is the fruit bat, which is also found on other islands in the Marianas chain. It is common knowledge that the fruit bat is a delicacy of the natives of the Marianas, and it is actively hunted for food on all the islands where it occurs. Evidently, the fruit bat has been heavily hunted in Pagan to support the appetites of the people in Saipan. The population of fruit bats has been diminishing very rapidly, but there is apparently an existing regulation which prohibits hunting of bats at certain times of the year. The other mammals on the island are all introduced and these include: cattle, pigs, goats, dogs, cats, and rats. The latter was most likely introduced acidentally.

Dogs, cats, and a few goats, pigs, and cattle live very closely with the villagers. The goats are mostly wild and are periodically hunted for food. The majority of cattle and pigs are left free to forage for food generally in the areas north of the present village. The cattle traverse a fairly large area and most, if not all, travel up the slopes to drink at the water reservoir. The present population of freely roaming pigs and cattle has been estimated at 400 and 200, respectively. Chickens are also present on the island. Most are in the village, although some probably escaped from domesticity and are now running wild in the woods.

Of the reptiles, geckos, skinks, and a few monitor lizards occur on the island. The invertabrates include more than a hundred species of insects, several species of spiders, few isopids, centipedes, and millipedes. Flies are the most notorious of insects on the island. The house fly, Musca domestica and a species of Calliphoridae are the most common and annoying to visitors as well as villagers. Mosquitoes are relatively scarce, at least in the month of January. Several species of dragonflies and butterflies were seen in and around the village and in the vicinity of the airstrips. Stinging wasps are evidently also common, but its notoriety is masked by the pesty flies.

Land crabs, as well as, coconut crabs are present on the island. Like the fruit bat, the coconut crab is a delicacy of the Marianas natives. This animal is also actively collected for food and ornamentation and its population is rapidly diminishing. Fortunately, it is presently protected by a hunting regulation just like the fruit bat.

FLORA

Pagan is a relatively young volcanic island. The last reported eruption of Mr. Pagan was in 1930. This is reflected by the evident pioneer nature of vegetation which occupy surfaces of recent volcanic flows.

The loose volcanic ash which covers large areas, especially on the west side, is vegetated largely by an almost pure stand of swordgrass, (Miscanthus floridulus). This forms a course, brake-like grassland 1 to 3 meters in height and in places very dense. On the steepest slopes above 250 meters in elevation, this grass tends to be shorter and the clumps more widely spaced. Above 450 meters it is sparse to absent.

Lava flows may be virtually bare, as on the northeast side of Mt. Pagan. However, they may support scattered clumps of Miscanthus and iron wood trees, Casuarina, as on the east and southeast sides of Mt. Pagan and the central upland of the southern part of the island. On many of the flows and lava cliffs to be seen along both sides of the island, they may be covered by almost pure forests of Casuarina. Casuarina and the fern Nephrolepis hirsutula are among the earliest invaders on new lava.

On plains of ash soil, the vegetation is generally grassland with scattered trees or clumps of trees. The trees may be Casuarina or any number of broad-leafed species. Many of these areas were under cultivation before World War II, but are now weedy. The Japanese planted rows of Casuarina and other trees as windbreaks. Jatropha gossypifolia, a fleshy-stemmed shrub, introduced by the Japanese in the late 1930's, has spread and now dominates large areas in the central part of the island.

Coconut plantations, both large and small, occur on many parts of the island such as on plains, in ravine mouths, and on steep slopes above the sea. Smaller clumps of coconut trees may be mixed with other broad-leafed vegetation on various parts of the island.

In the very few low wet areas such as around the lower and inner lakes and along the base of the caldera south of the airstrip, thickets of broad-leafed trees are fairly luxurient. Hibiscus tiliacius (wild hibiscus) and Terminalia cattapa (polynesian almond), among other broad-leafed plants, are fairly common. It is interesting to note that the area along the base of the caldera south of the airstrip supported mostly grasses back in the 1950's. The present vegetation of this area consists of luxurient mixed forest.

The vegetation in and around the present village is mostly of the domestic types such as bananas, citrus, mangoes, pineapples, and some castor bean plants. The ground cover is mostly grasses and shrubs of Crotalaria and Jatropha, with scattered shrubs of Stachyterphyta. Dense tangan-tangan occurs inland south and southwest of the present village and along the road leading to the old village. This plant spreads very rapidly and it won't be surprising to see it invading the slopes now occupied by swordgrass in the next 10-20 years. The plains in the vicinity of the airstrip will also likely be invaded. An interesting clump of mixed forest growing on large chunks of volcanic rocks occupies a small area just northeast of the present village. This gives an impression of an "oasis" surrounded by swordgrass. The black sand beaches of the two bays south and southwest of the village support the beach morning glory, Ipomea pescapri.

It should be noted that since Pagan island is relatively young, its vegetation is primarily of the pioneer types. However, evidently vegetative succession is progressing rapidly in some places, particularly in the wet regions.

SOCIO DEMOGRAPHIC SETTING

HISTORICAL CONSIDERATIONS

Accurate records concerning the people of Pagan were non-existent at the time the island was first discovered by western explorers during the sixteenth century. Several archaeological sites at Regusa, Talagi, and coastal sites near Sanmeina, give evidence of occupation of Pagan as early as several hundred years B.C.

Fossils or crop plants suggest possible settlement of the island prior to the great eruptions which culminated in the formation of the calderas. Volcanic outbursts, Japanese settlement of the island before World War II, and military actions have destroyed or removed most evidence of early habitation.

The available records indicate very little concerning land use during the periods of Spanish or German administration. Several cisterns dating back to German and Spanish periods have been identified. The Spanish interest and German interest was limited on Pagan and neither occupation has left much imprint on the island.

The Japanese period between 1914 and 1944 was the period of greatest economic activity on Pagan. Prior to the surrender of Pagan, there were as many as 3200 people on the island consisting of 300 indigenuous people, 300 Japanese nationals and 2,600 Japanese troops.

Japanese homes, barracks, stores and other buildings were built at or near the village of Shomushon, in the vicinity of Lagona Lake on the plains northeast of the inner basin and at

numerous scattered places along the coast line. During Japanese times copra and cotton exports and large quantities of sweet potatoes were exported to Japanese troops scattered in other parts of the Mariana Islands. A rope manufacturing plant and a small mining operation for sulfur were also initiated by the Japanese.

Present Settlement

Today all inhabitants live at or in the vicinity of Bandeera Peninsula and the former Japanese village at Shomushon. Prior to the 1970's most inhabitants lived in a small settlement on the north side of Laguna Lake. Laguna village was at the site of an old Marine Barracks built in 1950. Movement from Laguna to Bandera occured in the early 1970's in order to be near the harbor. Existing public facilities include the power plant, copra warehouse, church, dispensary and a one room school house.

POPULATION

Population of Pagan varies considerably as migration to and from Pagan occurs during the school year. Presently the school system provides education through the seventh grade at which time the junior high school age students are sent to Saipan.

Pagan has a reported population of about 85 persons representing nine families; however, this number includes many persons now living on Saipan. In October 1977 there were only 37 persons on the island distributed among seven families. Population as recorded by the Resident Commissioners office during December 1977 indicated a total of 51 persons. The existing grade school population was thirteen (13).

The highest recorded population of Pagan was during World War II when some 3,200 persons - 300 Saipanese, 300 Japanese nationals and approximately 2,600 Japanese troops were stationed on the island. The 1941 population of 300 Saipanese consisted of

some 65 families brought to Pagan on contract to work coconut plantations and other agricultural endeavors. Population declined drastically right after the war and has experienced a more gradual decline since. In 1970 a land use report prepared by the Mariana Islands District Land Management Office indicated a population of thirty-one. This sharp decline was probably due to Typhoon Jean which damaged many of the homes and destroyed most of the coconut plantations causing several families to relocate to Saipan. Since 1970 the population has risen slowly as several families have returned.

To make population projections for Pagan would be at best rough approximations. Until infrastructure improvements are made, and the land tenure problems resolved both population and economic growth will be limited.

LAND TENURE

The entire island is public land and the Paganese have in a sense, been squatters on their own island for thirty years. Without ownership, residents complain they have no incentive to improve the land.

The Commonwealth Constitution requires that public lands continue to be made available for a homestead program. An eligible person may have only one village and one agricultural homestead. A homestead must be held for at least three years for a person to receive freehold interest, and then must be held for an additional ten years before the homestead may be transferred.

A special provision of the Constitution allows those persons who have used public lands continuously for fifteen (15) years or more at the effective date of the Constitution to apply for homestead ownership of those lands if they meet other homestead requirements.

A continuous use of public land means residing on the same land for fifteen years, using the land for agricultural or commercial purposes for fifteen years, or a combination of residence and agricultural or commercial use as long as the land has been used continuously. It will be necessary for the Public Land Corporation to determine those persons qualified and to survey the lands.

An as-built survey of existing facilities and a proposed village homestead at the old Japanese Village of Shomushon were prepared by the Land Management Division in 1965, however, monuments were never set. A new survey should be initiated as it is suggested that the proposed land uses identified within the village should be altered to meet changing conditions. It is also necessary for the determination of existing claims on public lands allowed for by the Constitution.

ECONOMIC DEVELOPMENT

Farming and fishing are a major element of the islands economic base. Cash income is derived mainly from copra production, plus several government salaries (four salaried employees as of January 1978) and the sale of fruit bat and coconut crabs to Saipan. In 1976 total copra production was approximately 75 tons generating a cash income of about 13,000 dollars.

There are no stores on Pagan or evidence of cash exchanges among residents for goods or services. Commercial representatives of Saipan's stores travel to Pagan on the quarterly field trip ships, and bring clothes, food, cigarettes, alcohol, tools and other items to sell to the island's inhabitants. It is likely that these sales are made on terms highly disadvantageous to the Paganese. Pagan's families also participate in the USDA Needy Family Food Distribution Program. Food shipments are made by field trip vessel.

Pagan has limited potential for development. Technically, agriculture could probably be expanded to some extent around a range of commercial field fruits and fruit trees that prefer volcanic soils (pineapples, etc.), but before too long the problem of water would pose a serious constraint. Furthermore, Pagan has no real natural advantages for agriculture over the three major islands, and even with improvements to its harbor and airfield, its relative inaccessibility to existing markets means that it would be at a disadvantage in trying to develop commercial production.

Tourism might have some possibilities, at least for a special type of visitor bent on "roughing-it" and enjoying hiking, deserted beaches, and natural beauty. Fishing and hunting activities should be considered as possibilities for creating limited economic development. Wild goat and boar hunting trips are possibilities as a means of creating some employment for islands residents. It might also help alleviate a potentially dangerous problem as wild boar populations are discouraging copra production in the north plains area and on lands along the southeast coast.

Proposals have been put forth to develop hotels on Pagan - one by Micronesian Development Corporation (MDC), another by a Japanese group (Ikeguchi and Castro, November 1975) - but it is difficult to believe that these are really serious. Again the relative inaccessibility and high costs of transportation to Pagan are severely limiting factors, both in terms of development of even modest visitor facilities, but especially in generating a reasonable flow of visitors to occupy them. However, with improved transportation from Saipan it might be possible to interest a Japanese group in establishing a "Club Mediterrane" operation on Pagan, and to assist them in doing so with government tax breaks and the like.

One interesting possibility for Pagan might be the exploitation of the Island's basalt deposits. Markets would be found primarily on Guam and Saipan in road-building activities. Recent investigation by the Government of Guam Department of Public Works suggests that although the basalt resources are sufficient the cost of infrastructure improvements necessary to mine, process and transport the basalt may be prohibitive. Joint development funding including CIP development funds from the Northern Mariana Islands CIP program, Economic Development Authority Funds, Federal Aviation Administration, ADAP funds and finally a long term contract for supplying basalt aggregate to Guam would appear to be necessary to make such a program successful.

Recently, two other proposals have been suggested which bear some consideration during the preparation of future development plans. A report concerning a proposed oil storage facility on the island of Maug suggested that Pagan be used to house between 200 and 400 persons who would either be support personnel or family of those working at the Maug facility. A second proposal suggests the utilization of Pagan to develop geothermal energy resources and locate energy demanding industrial facilities. Both proposals are speculative at best. It would take several years to develop detailed plans and implement such ambitious programs. Before implementing such projects, a much more thorough assessment of the environmental impacts must be undertaken.

Summary

During the plan period, the technical and economic potential for exploiting basalt should carefully be explored as should the possibility of developing a visitor industry facility. It appears that the most realistic program strategy for Pagan and the Northern Islands during the plan period is to try and improve the quality and level of services it offers to the Paganese.

LAND USE

PURPOSE AND OBJECTIVES

PROPOSED LAND USES

PURPOSE AND OBJECTIVES

The proposed Land Use Plan for Pagan is based on a premise that minimum development is envisioned during the planning period. The Pagan Island Land Use Proposal plan prepared in 1970 by the Mariana Islands District Land Management Office and the earlier Military Geology report for Pagan were both utilized to determine overall land capabilities and to ascertain historical land use patterns.

The Land Use Plan is sensitive to the environmental constraints and the availability of resources. Of necessity the plan respects the traditional lifestyle of the local citizens, their desire to have decent housing and to actively shape the future of Pagan through individual choice of style and expression. Principal objectives which were pursued in the plan include

* To recognize and respect the traditional lifestyle of the Northern Marianas people, including the desire to own and occupy land.

* To recognize natural environmental constraints such as water, topography, and soils in the dimensioning and location of future growth and to preserve and conserve land with valuable ecological characteristics, recreation uses, or scenic appeals.

* To encourage agriculture as a viable economic use of suitable land.

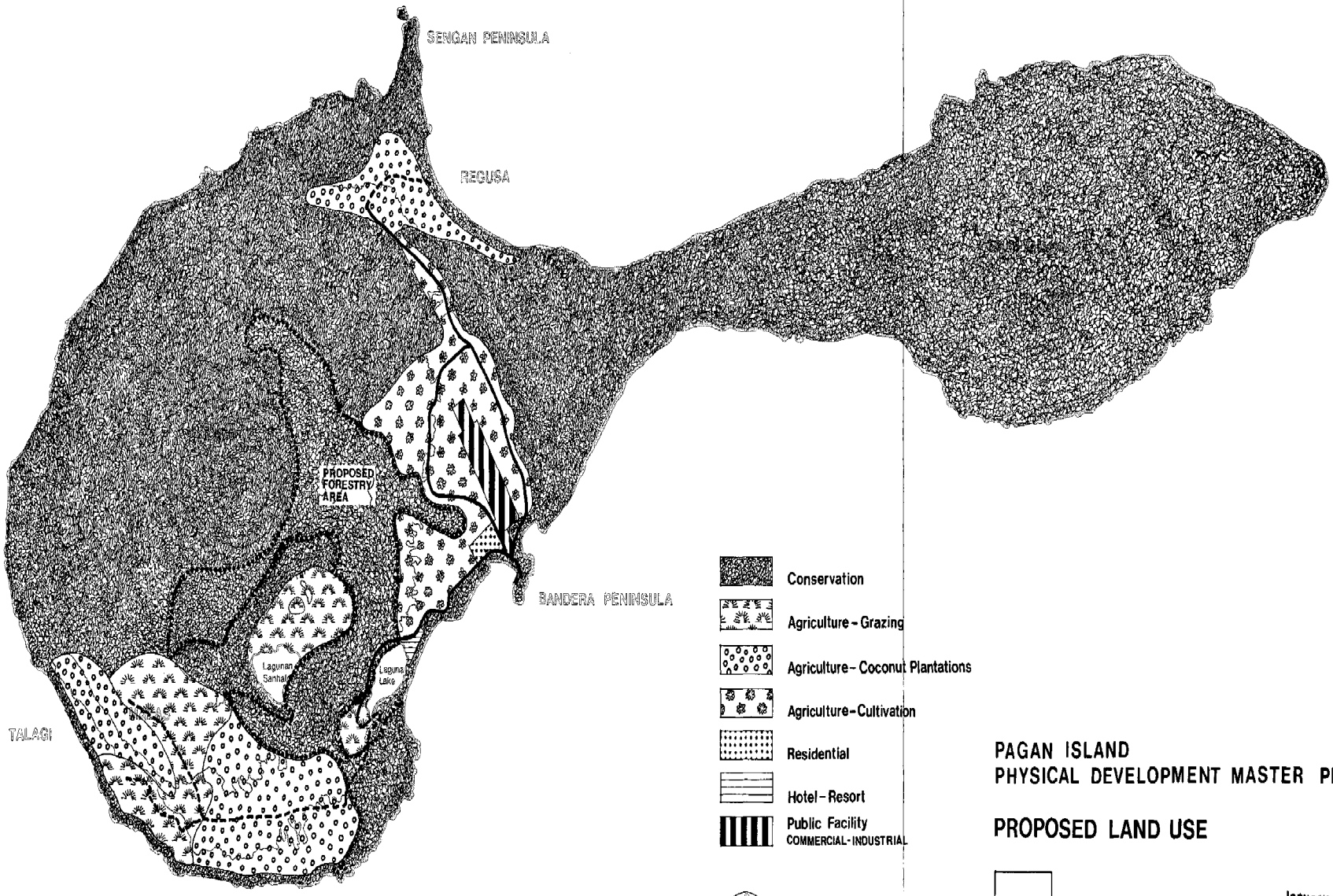
* To provide for or allocate suitable and sufficient sites for residential, business and industrial needs to meet anticipated growth.

* To minimize public ownership and access to beaches and estuarine lands to insure their preservation, conservation

or greatest public use and to provide adequate areas for public parks and recreation facilities.

* To coordinate urban growth with the availability and growth of public services including water, power, transportation facilities and sewer.

On Pagan it will not be necessary to develop the numerous land use zones as have been proposed for Saipan, Tinian and Rota. Proposed zones will include Conservation, Agriculture, Residential (a Village Homestead Area), Commercial-Industrial, and Hotel Resort. Further discussion of each zone is included in the following section.



PAGAN ISLAND
PHYSICAL DEVELOPMENT MASTER PLAN

PROPOSED LAND USE

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PROPOSED LAND USE ZONES

CONSERVATION

The Conservation Zone provides for the preservation and protection of natural resources such as watersheds, unique animal and plant habitats, historic and cultural resources, scenic resources including prominent topographic forms and features, and outstanding views and attractive wilderness areas. The Conservation Zone also establishes a mechanism to preserve unique geologic or vegetative sites such as steep offshore reefs and lagoons, beaches, beach parks and general parks.

Geographic Areas

With exception of the low coastal area near Regusa, the entire South Volcano area has been included in conservation lands. Further included are all the lands in the North Caldera exhibiting rugged topography, including shoreline and beach areas, former remnants of the caldera rim, the ash covered slopes of Mt. Pagan, and several specific sites including Sengan Peninsula and portions of Bandera Peninsula. Portions of the basins containing Laguna Lake and Lagunan Sanhalom (including the hot springs) should also be placed in conservation lands.

Historic Sites

Sites of early Chamorro occupation include latte sites at Regusa and at Talagi Beach as well as several coastal sites in the South Volcano conservation area. Several shrines from Japanese occupation and foundation dating from either German or Spanish occupation should also be included in the historic sites. An inventory identification and evaluation of sites is necessary and should be initiated by the Historic Preservation Officer.

Beaches

Pagan has approximately 27 miles of coastline, most of which would be classified as rugged. Low plateaus and high sea cliffs interspersed with small pocket beaches and a few longer basalt or calcareous sand and cobble beaches form the shoreline. Some 22 beaches comprise about 7.5 miles of beach.

Immediately north and south of Bandera Peninsula are approximately 6300 feet of smooth, steep, soft black volcanic sands in three distinct beach developments separated by lava flows or pyroclastic deposits. There is no reef margin developed adjacent to these beaches and they are subject to rapid erosion during typhoons or major storms. These are the only beaches which are suitable for swimming.

Laguna Lake and Inner (Sanhalom) Lake also provide opportunities for water related activities in a more protected environment.

AGRICULTURAL LANDS

The Pagan Island Land Use Proposal prepared in 1970 identified between 1,700 and 2,000 acres of land suitable for agricultural uses. Generally these areas lie on the western side of Mt. Pagan on the plains of the old caldera floor. Other 'good' agricultural soils include small areas adjacent Laguna Lake and Inner Lake. Most of the lands so identified are considered to be marginal as the soil is often only five to ten inches deep.

Agriculture on Pagan follows pretty much traditional practices and technology. A few family plots of staple items such as red taro and sweet potatoes, plus vegetables such as eggplant, okra and chinese cabbage were observed. Scattered banana planting are also in evidence, as well as pineapples, which were apparently grown during Japanese times and have continued in a semi-wild state since. Given the condition and random siting

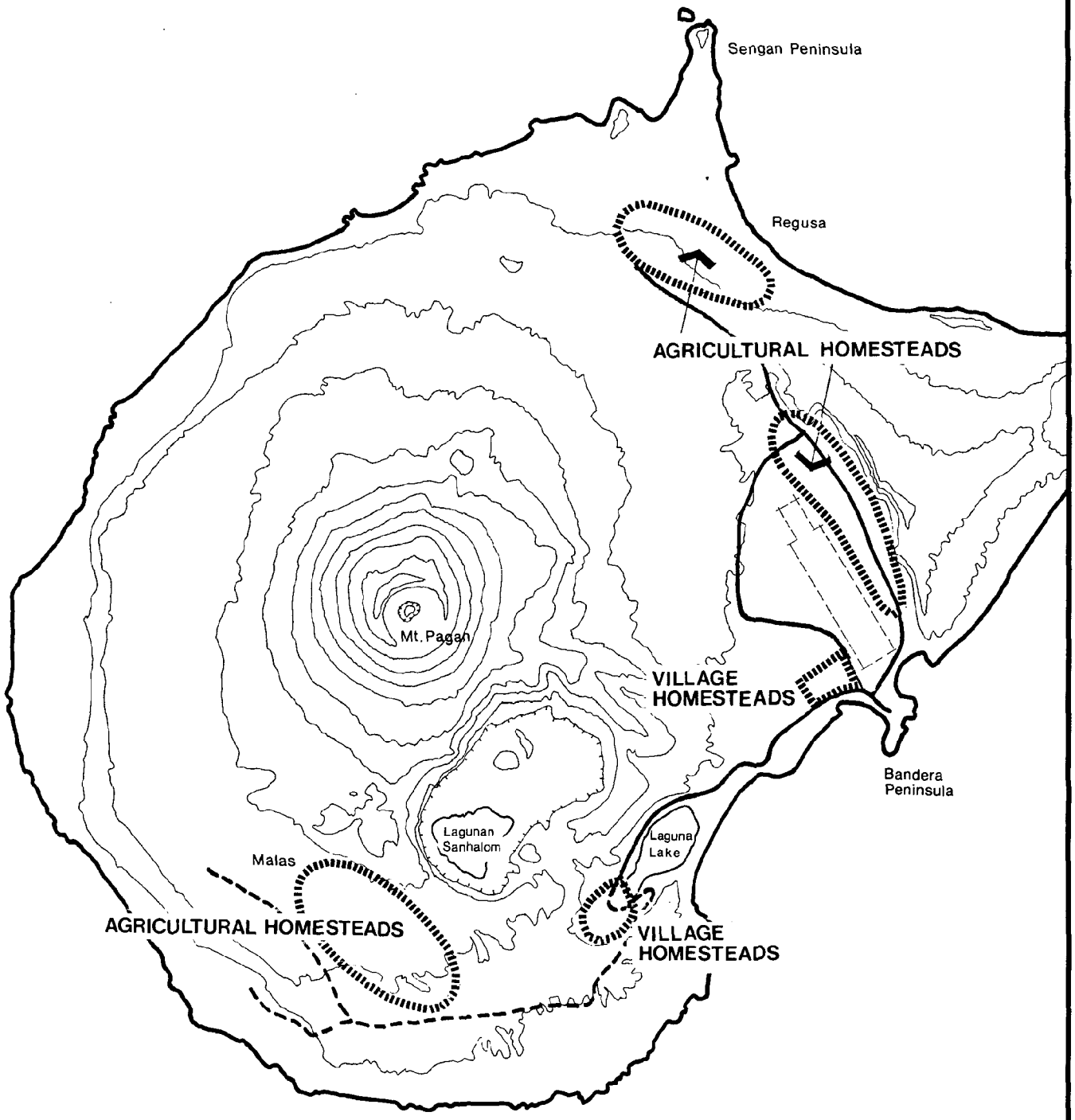
of farm plots, it is impossible to estimate agricultural acreage currently in use. All plantings (staples and otherwise) appear to receive minimal cultivation and care, though an agent from Agriculture often accompanies the field trip vessels and brings seeds, and agricultural chemicals for sale.

A 1950 report stated that "the Japanese had been experimenting with cotton, cassava, and pineapple plantations as well as producing considerable quantities of sweet potatoes and other vegetable. The extensive coconut plantations had not been affected by these experiments and the coconut controlled the economy of this northern area." Estimates obtained from former Saipanese occupants of Pagan Island place the copra tonnage exports at about 1500 tons annually during the years of 1939 and 1940.

Coconut trees on Pagan were severely damaged by Typhoon Jean in 1968 and present day production is less than one-tenth of former levels. Unless replanting of coconut trees is undertaken, the Pagan copra industry will never again attain its former level of production. The Land Use Map (see Plate 3) suggests the various locations for agricultural lands. Truck crop agriculture is limited by topography and soils to lands adjacent and south of the airport and to lands near the existing village. Subsistence agriculture is probably best developed near Regusa and Sengan Peninsula on the East and the Talagi area (North Plateau). These areas should also be replanted to further encourage copra production. It will be the responsibility of the Public Land Corporation to designate lands for Agricultural Homesteading. It is suggested that portions of Regusa, Talagi and the area south of the airport along the caldera rim be so designated (see Plate 4).

RESIDENTIAL

Two principle areas for residential development are proposed. The first is at the present village site near Bandera Peninsula. The second site is the lowland adjacent to Laguna Lake.



PAGAN ISLAND
PHYSICAL DEVELOPMENT MASTER PLAN

PROPOSED HOMESTEAD AREAS

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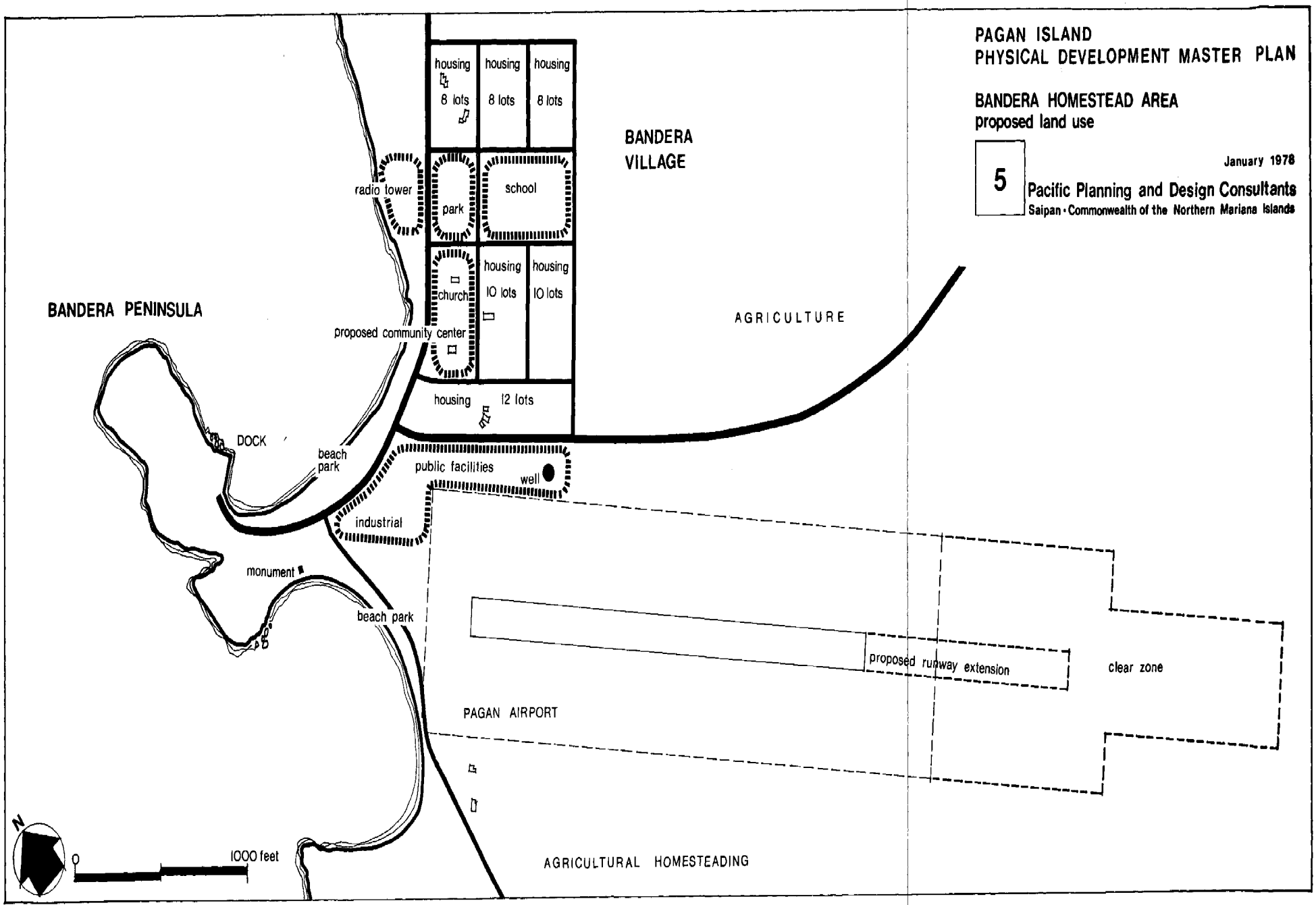
PAGAN ISLAND
PHYSICAL DEVELOPMENT MASTER PLAN
BANDERA HOMESTEAD AREA
proposed land use
5
January 1978
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BANDERA VILLAGE
housing 8 lots
housing 8 lots
housing 8 lots
radio tower
park
school
church
housing 10 lots
housing 10 lots
proposed community center
housing 12 lots
BANDERA PENINSULA
AGRICULTURE
DOCK
beach park
public facilities
well
industrial
monument
beach park
proposed runway extension
clear zone
PAGAN AIRPORT
N
0
1000 feet
AGRICULTURAL HOMESTEADING

Although it is not suggested that the Laguna Lake site be developed during the present plan period, it is suggested that the site be retained in public ownership for its eventual development into a village homestead area.

The existing village site at Shomushon should be renamed Bandera Village Homestead Area and a new plan developed. A preliminary site plan based on the 1965 As-Built Survey Map is presented in Plate 4. It will be necessary to conduct a survey and prepare a final lot plan. The initial village scheme should accommodate between fifty and sixty lots and incorporate whenever possible existing structures. The public facilities, dispensary, school house, and future civic center area should be located so as to allow expansion as island population increases. A small area should be set aside for the future development of a one stop commercial area or general store.

COMMERCIAL-INDUSTRIAL

The need for Industrial and Commercial lands during the immediate plan period is limited; however, to provide adequate area for future public facilities and possible private commercial and industrial needs, it is suggested that all land on Bandera Peninsula be zoned Commercial Industrial.

For commercial activities beyond the intensity of occasional services or the "mom and pop" store, it is suggested that such activities be required to locate whenever possible in the Commercial Industrial area. Existing homes should be allowed to remain but as nonconforming uses. Exchange parcels in the Bandera Village Homestead area would be made available to the several families presently inhabiting the peninsula. The entire peninsula would be held in the public domain and be leased to private entrepreneurs for commercial or industrial usage or be available for necessary public facilities such as harbor back up space, copra warehouse, and supply storage areas would also be included within this zone.

HOTEL RESORT

Presently Pagan provides unique opportunities for "campers and tourists" bent on roughing it. Numerous sites can be mentioned which exhibit natural or scenic beauty. The white sand beaches at Regusa, Togari Rock, Sengan Peninsula, Mt. Pagan and South Volcano, Laguna Sanhalom (Inner Lake) and its associated "hot springs" and the black volcanic sand beaches along Pagan's western coastline are but a few of the natural features with which Pagan is blessed. In the future, should transportation links to Saipan improve, the economic incentives for the development of small scale tourist facilities should occur.

One site in particular warrants immediate consideration as a location for a future tourist facility. This site overlooks Laguna Lake and the northern-most stretch of black sand beach. The site was thought to have been the former location of the Japanese communications and command post. It is recommended that this site be designated for a future hotel resort site.

Other sites on Pagan have potential for development into limited tourist resort facilities. Facilities to be provided would generally be no more than small cabins or huts that would be constructed and maintained by the local people. The system would be similar to the "primitive camping areas" that have developed in the National Park System. Development of some trails for hiking and limited jeep trails are all the improvements that are envisioned during the short range plan. Such areas include Regusa and Sengan Peninsula on the eastern coastline and Inner Lake, Talagi and the Laguna Lake basin. Their exclusion from hotel resort facilities does not suggest that these sites should not be developed as resort or recreational facilities; however, by initially placing these sites into Conservation or Agriculture zones, proposed development plans will be required to prepare an impact assessment on potential environmental impacts, thereby making certain that proper development standards and environmental controls can be imposed.

PUBLIC FACILITIES

HEALTH FACILITIES

EDUCATION

HOUSING

HEALTH FACILITIES

The existing dispensary was constructed by the Sea Bee's Civic Action Team back in the early 1970's. The building is of plywood construction and presently houses the island's communication equipment. The facility has suffered from lack of proper maintenance and the plywood walls are rotting out.

Pagan is to receive a modern dispensary through the Hill-Burton program. With the construction of this dispensary, health facilities should be adequate to provide for the immediate attention to those persons who become ill or injured on Pagan.

A medic was recently trained on Saipan and has returned to the island to assume health service functions of the island. Advice is sought from Saipan by radio when it is necessary or when evacuation of sick or injured persons is required.

EDUCATION

Pagan's school population presently has thirteen (13) students in grades one (1) through seven (7). Students going beyond the seventh (7th) grade travel to Saipan and live with relatives.

The educational building is a one room facility constructed with plywood and tin by the Civic Action Team in the early 1970's. The open styling of the structure with only screens for protection has allowed driving rains to penetrate into the building damaging the interior. Chairs, tables, books, and equipment were all seriously water damaged. A small section of the roof had also failed. Many of the plywood panels have also rotted through.

In 1978 some ten classrooms are proposed for Saipan and the Northern Islands. It is suggested that the funds for one of the classrooms be programmed for Pagan to allow for the construction of a new facility. There will also be a need for operations to budget monies to Pagan for equipment and supplies.

The new village plan for Pagan includes a minimum of a two- or three-acre site for educational facilities. Proposed facilities have been located so as to be easily expanded. During the initial plan period it is doubtful that facilities beyond the presently planned classroom building will be necessary.

HOUSING PROGRAM

Presently there are only seven occupied homes on Pagan all of which are considered to be substandard construction. Federally assisted housing programs, available through Housing and Urban Development, Farmers Home Administration and local assistance as provided by the village homestead program will be available during the plan period to meet housing needs.

On Pagan,implementation of a village housing program will require:

* The surveying of lands and development of village homestead sites. It is recommended that the village homestead site incude the existing settlement.

* Provision of services especially water and power improvements.

It is recommended that $100,000 of the funds to be programmed to the Homesteading Program be designated to Pagan for the necessary surveying, planning, and should funding be sufficient, the implementation of minimal infrastructure improvements. A Village Homestead Program for as many as 50 to 60 homesteads should be developed. It should include a total plan for the development of Bandera-Shomushon. Improvements and reconstruction of the water line from Pagan mountain or suitable replacement with ground water development are discussed in the Public Utilities Chapter. Power improvements would be completed with funds proposed in 1978 although it is important that proposed power plant and distribution improvements be coordinated with the ultimate village design.

PUBLIC UTILITIES

WATER

POWER

SEWERAGE

SOLID WASTE

COMMUNICATIONS

WATER

EXISTING CONDITIONS

The present water supply for village residents is dependent upon the utilization of individual catchment basins and one Japanese vintage well constructed on the north side of the airport. In the early 1970's the Sea Bees Civic Action Team constructed a catchment basin and storage tank on the flank of Mt. Pagan. A four (4) inch transmission line connects the storage tank with the village at Bandera (Shomushon). Soon after the construction of the system, typhoon winds destroyed the rubber membrane of the catchment basin. The storage tank and most of the pipeline, however, are still in place and in generally good condition. Several sections of pipe near the village require replacement. The storage tank itself was overflowing during a site investigation in January 1978, despite the limited catchment area which remains functional (see Plate 6).

Presently, the inhabitants rely on 55-gallon drums or renovated Japanese cisterns to store potable water. During the plan period, it will be necessary to continue the utilization of these cisterns, minimally as a back-up system and perhaps as the major system should the costs to reconstruct the old system or develop a new system be prohibitive.

PLANNING FACTORS

Present consumption of water on Pagan is most probably less than ten (10) gallons per capita daily. Total consumption for the island would be approximately 500 gallons per day based on the estimated population of 51 persons. On Pagan, the limited water supply available through the individual catchment systems has made the Paganese water conservation conscious. Future

water requirements are difficult to assess, based on limited knowledge of population and economic growth. Assuming that the per capita consumption would not rise above 40 or 50 gallons per person and that population would not exceed 200 persons during the plan period, the overall average daily water requirements are not expected to exceed 8,000 to 10,000 gallons per day. This amount of water could easily be provided by either catchment basin or development of ground water resources.

Several alternative schemes should be considered in developing or renovating the water distribution system. These include:

* Reconstruction and renovation of the existing catchment basin and distribution system

* Development of ground water resources and a new distribution system.

* Continue the existing system of individual catchments and utilize the existing Japanese well as a community facility.

The advantages and disadvantages of each alternative are discussed in greater detail in the following paragraphs.

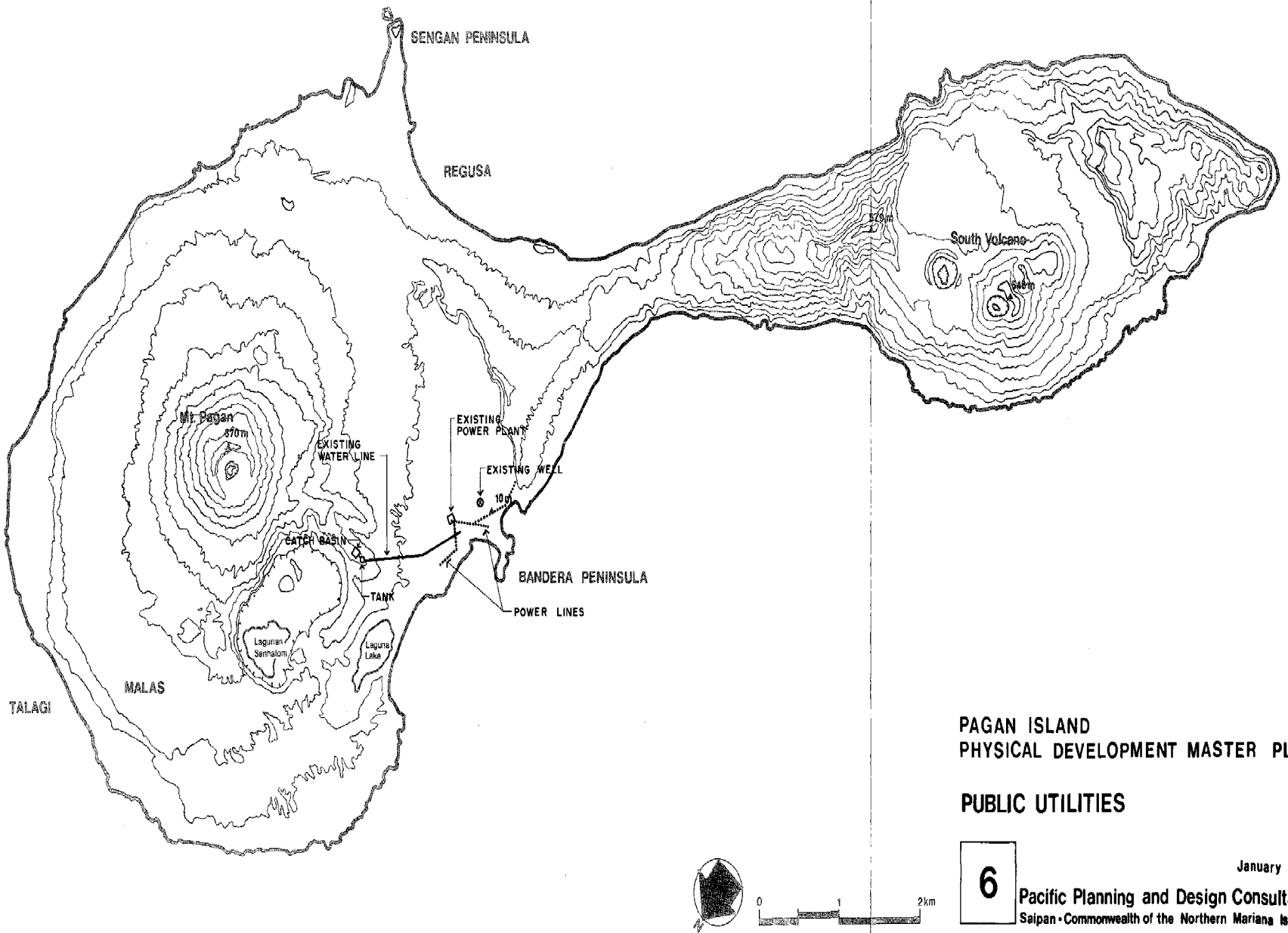
Reconstruction of the Catchment Basin System

Reconstruction of the existing catchment area and renovation of the storage tank and transmission line have the following advantages:

* Generally, the tank and the transmission line are in good condition and can be utilized with very little rehabilitation work.

* Water will generally be low in chlorides and hardness.

* The system is mechanically simple.



PAGAN ISLAND
PHYSICAL DEVELOPMENT MASTER PLAN

PUBLIC UTILITIES

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Several disadvantages of the system include:

* Water catchment area is limited in size and the system's overall reliability depends on rainfall intensity and frequency.

* The entire catchment basin requires reconstruction, including a new membrane, fencing, and typhoon proofing.

* Catchment water is subject to biological and debris contamination and will require treatment by filtration and chlorination.

The estimated cost for reconstruction of the system is more than $60,000, most of which is the cost for reconstructing the catchment basin.

Development of Ground Water Resources and New Distribution System

An alternative to the reconstruction of the existing system would be the development of ground water resources on the plains east of the proposed village. The advantages of such a system are that it:

* Would provide a more reliable source of water once a well is properly developed; and

* Would require little or no treatment of the water.

The disadvantages of developing ground water resources include:

* Wells are subject to salt water intrusion. Previous studies indicate that chloride content would probably be between 50 and 500 ppm.

* Overall system needs would require the development of a new well, pumping equipment, storage tank, and additional transmission line between the well site and the village.

* The system utilizes pumps and electricity and thereby requires more maintenance.

Estimated costs for such a system include approximately $40,000 for new well development, $20,000 for a 10,000-gallon storage tank, and approximately $60,000 for the purchase and installation of about one mile of four-inch transmission main. With the required A&E design, overall cost would probably be in excess of $130,000. Some of the existing transmission line might be salvageable; however, until final design, it would be impossible to determine the extent of the savings.

Reconditioning of the Existing Japanese Well

One remnant of the Japanese water supply system is a dug well approximately 30 feet in depth located just north of the airport. Should further study indicate the well to be productive, the cost for well construction and need for an estimated one mile of pipe would be eliminated. The cost of redeveloping this well, including a new storage tank of about 10,000 gallons, and the construction or salvaging and relocating of the pipeline to the existing reservoir could probably be completed for 50 or 60 thousand dollars.

One major concern of this system is to provide a suitable location for the storage tank. It would probably be necessary to elevate the tank to attain desired pressure.

RECOMMENDATIONS

Costs for renovating or improving the water supply and distribution system on Pagan will be extremely high. During the short-range plan (1978-1985), the continued utilization of present catchment systems and cisterns is recommended. The existing Japanese dug well should be covered to guard against contamination and a small pump and minimum size storage tank be constructed to provide for emergency water needs. A five

thousand gallon tank and a sump pump with minor renovations to the existing well could probably be completed for less than $15,000.

At present, large-scale improvements require a commitment of resources which is presently not justified by the existing population. Should population growth become significant either because of the relocation of those persons presently inhabiting the other northern islands or because of increased economic activity on Pagan, then further investigation of a system would be warranted.

POWER

Existing power generation equipment consists of two 20 KW Kato generators housed in a small CMU structure and an emergency 10 KW generator which is located at the dispensary. All are in working order although the Kato generators are old and it is difficult to obtain parts for them.

The existing distribution system consists of approximately 3600 feet of single phase line in two sections one of approximately 1400 feet connecting the dispensary, school building, and residences to the north. The second line approximately 2200 feet in length provides power to four residences and the copra shed. The present peak demand is estimated to be less than 10 KW. Voltage drop losses are probably due to the length of the simple phase system (see Plate 6, pg. 41).

PLANNING FACTORS

In 1978 $50,000 has been proposed for the extension and improvement of the power system. Original plans were to purchase and install a 50 KW generator. As an alternative to the purchase and installation of one 50 KW unit it is suggested instead that either two 20 or 25 units be purchased and installed. The existing 20 KW units could be utilized as a stand by generator by cannabilizing one for parts. With three units the largest being 25 KW the firm capacity of the system would be 45 KW. It is doubtful that the demand for power on Pagan will exceed twenty-five (25) KW for several years making it possible to use just one unit initially thereby minimizing fuel costs.

It is suggested that the remaining monies be utilized for the improvement of the distribution system. Much of the line is old and frayed and coconut palms and tangan-tangan trees are being utilized as poles. It should be possible to replace

most if not all the temporary poles and also string new wire that can avoid some of the voltage loss.

On Pagan more so than on the other islands, anticipated changes in power demand will need to be monitored carefully. Presently, it is planned that Pagan receive a reefer facility for cold storage of fish and other foods. If it is necessary to purchase a three phase unit, it is recommended that the reefer facility be bought with its own generator unit. If a single phase unit is available it will be possible to hook up to the existing system as long as the distribution line lengths are minimized. A reefer facility of size similar to units handled by Sea Train requires about 15 KW to start the system; however, load requirement quickly drops to between 5 and 7 KW which should easily be handled by the existing 20 KW Kato unit or proposed 25 KW units. Should power demand increase significantly, it is recommended that a 4 KV system be installed; however, such a proposal assumes that persons capable of maintaining the system are living on Pagan.

SEWERAGE

The primary means for sewage disposal on Pagan are outdoor privies. Cooking and washing waters are usually dumped directly unto the ground or into a sink which is connected by pipe or rubber hose, and which in turn, discharges to the outside. The present population of Pagan is less than 50 persons. To project sewage flows based on Saipan standards for the existing and projected populations would be inappropriate because of the obvious low water usage. Assuming a reduced flow generation rate of 40 gallons per person would suggest that the amount of sewage discharged would be 2000 gallons daily. Even this amount can be considered high based on the present standard of living. On Pagan, concern for the location of privies and eventually cesspools and septic tanks requires that these facilities be properly sited so as not to provide a source of contamination for cisterns or shallow wells that might be developed along the coast.

A sanitation problem exists on Pagan which is often manifested by a large fly population. A discussion of some unsanitary practices is included in the section on Solid Waste. It is recommended that an education program to teach proper sanitation practices to the Pagan people be initiated and pursued jointly by the Department of Health and Environmental Services and the Department of Education.

During the plan period it is recommended that the residents of Pagan continue the individual disposal of sewerage either through privies, cesspools, or septic tanks. Septic tanks, cesspools, and privies should be sited as far away as is possible from catchment basins, cisterns, or wells. A minimum distance of 50 feet is recommended until such time as further studies establish the criteria which should be followed to minimize the risk of polluting ground water resources.

SOLID WASTE

The solid waste situation on Pagan is similar to situations in most rural villages of Saipan. This is attributable to the living standards of the people and the custom of disposing wastes near the homes. This custom is generally practiced in Pagan, where piles of garbage near houses have become part of the village setting.

The refuse piles near the houses consist mainly of bones, paper products, some cans and bottles, pieces of metals, grass cuttings, coconut husks, and other plant material.

PLANNING FACTORS

Although most of the household rubbish and garbage are disposed in piles near the homes, some residents use damaged, uncovered cisterns as dumping sites. These cisterns are in the village proper and some very close to the houses. Two of these cisterns are close to the school buildings and are being used to discard school paper products. While most of them are relatively empty, the one close to the school is nearly full.

Cans and bottles are uncommon in Pagan, perhaps because beer and soft drinks have not yet invaded the island or have not yet become part of the everyday diet of the residents. It will not take long for bottles and cans to become the major components of solid wastes in Pagan once they are introduced.

As can be deduced from the foregoing discussion, Pagan has no community dumping sites. Disposal of solid waste, therefore, has become a strictly individual family practice.

The per capita production of solid wastes in Pagan is obviously significantly lower than in Saipan, Tinian, and Rota. This can be explained by the fact that commercial products are

minimally imported into the island. The needs of the inhabitants for food are, for the most part, satisfied by and derived from the island's natural resources. This condition will persist as long as the population remains relatively small and constant. However, with an increase in population, even to 400 people, the economic picture will change dramatically. Eating and other habits will significantly change and there will be an increasing dependence on commercial products.

Fly Problem

Pagan has become notorious for its fly problems. Visitors and residents alike have told stories, sometimes unbelievable, about the enormous population of flies during most months of the year.

The enormous population of flies in Pagan perhaps can be brought to perspective when their life histories are understood. Since the housefly is the most prevalent of the pesty flies in Pagan, its life history will be used here as an illustration.

The housefly passes through complex developmental stages from egg, larva (maggot), pulpa, to adult or fully winged fly. Under warm summer temperature (between 80-90^{o}F) the egg stage requires 20 hours, the larval stage about 5 days, the pupal stage about 4 days, or a total of about 10 days from egg to adult. Female flies begin laying eggs from 9-12 days after emerging, but under certain condition they may begin egg laying even as early as three (3) days. Each female fly is capable of depositing 75 to 150 eggs at one laying. It has been reported that a single female may deposit over 2,300 eggs in 31 days. The high reproductive capacity of the housefly and the short time necessary to reach maturity is one major factor that contributes to the large fly population.

Physical and biological factors which affect development of flies include temperature, humidity, availability of food, and other organisms in the environment. In order to further understand the fly problem in Pagan, the environment in which these flies occur and multiply must be brought into focus.

The housefly can breed in a variety of organic media such as cattle, pigs, cats, dogs, and chicken manure, as well as in human excrement. Moreover, they are capable of developing to maturity in garbage, outdoor privies, decaying vegetable matter, dead animals, and in most any decaying organic material.

It seems that the environment of Pagan offers plenty of opportunities for the development and multiplication of pests. The average temperature of 80° F and the abundance of food source in the form of excrements of cattle, pigs, chicken dogs, human, etc., seem ideal condition for the flies and rats. As long as animal excrements are abundant, and as long as garbage and other organic material are indiscriminately disposed of, the pest situation will persist. The problem in Pagan, is definitely one of sanitation. While the solution to the problem involves simple sanitary practices, the plan for control may be complex and require cooperation and education of the residents.

COMMUNICATION

EXISTING CONDITIONS

Except for the occasional arrival of air taxi flights and the field trip vessels, Pagan's only link with the rest of the NMI, is provided by high frequency radio (HFR).

The radio unit is located in the dispensary and is powered by a 10KW generator. It is operated primarily for official government business but has been most instrumental in relaying requests for emergency medical evacuations and other such urgent matters.

Island to island contact is, however, highly dependent on skip and propagation conditions. Not infrequently, unclear signals are received hampering, if not totally disrupting, communications.

FUTURE EXPANSION

Because of the tenuous nature of the existing radio communication system and because the population is too small to justify more sophisticated networks, future expansion of communications will continue to focus on the radio system. To be sure, a more reliable unit is needed especially given the essential function the radio serves in emergency situations. Provision of other communication media are not anticipated for the short range period.

Should the need arise in subsequent planning horizons, it may be possible to provide telephone service via the utilization of solar-pack micro-wave transmitters. The transmitters can be located on the islands between Saipan and Pagan, thus taking advantage of the short distances between these islands. The costs for such a system will be expensive, however, and such a system should be carefully evaluated for cost effectiveness before implementation.

TRANSPORTATION

AIR

WATER (HARBORS)

ROADS

AIR

Transportation plays a key role in any program undertaken in the development of Pagan. Air transportation is the principal mode of travel to and from the island. Island residents are highly dependent upon air transportation for perishable foods, medical supplies, many durable goods, and personal travel, which places a priority on safe and reliable air transportation and efficient airport facilities.

EXISTING CONDITIONS

The airfield and its supporting installations were built by the Japanese prior to or during World War II. The runway was approximately 2500 feet long and 190 feet wide. The flight-strip itself is about 3,000 feet long and 1000 feet wide. The west end of the facility is on fill as much as 15 feet thick, the eastern end is cut into clinker lava flows with excavations up to 20 feet deep. Concrete drainage ditches were built on either side of the runway and were utilized for water catchment but these facilities have since been destroyed.

In the early 1970's, the Sea Bee's Civic Action Team regraded the airfield. Since that time work has been minimal, with only occasional clearing of trees in the approach zones and mowing of the runway.

PLANNING FACTORS

The immediate objective of the Mariana Islands Airport Authority is to attain and retain air carrier certification for its existing air carrier airports in accordance with the FAA safety and operational standards, Federal Aviation Regulations, Part 139. This is planned to be accomplished by January 1978, when the Northern Mariana Islands assume commonwealth status.

The needs of the Northern Mariana Islands for airport improvements are limited to items essential to enhance the safety and operational efficiency of the critical aircraft those governing the maximum requirements. These include minimum paved runway lengths, adequate runway safety areas, cleared approach and transitional surfaces.

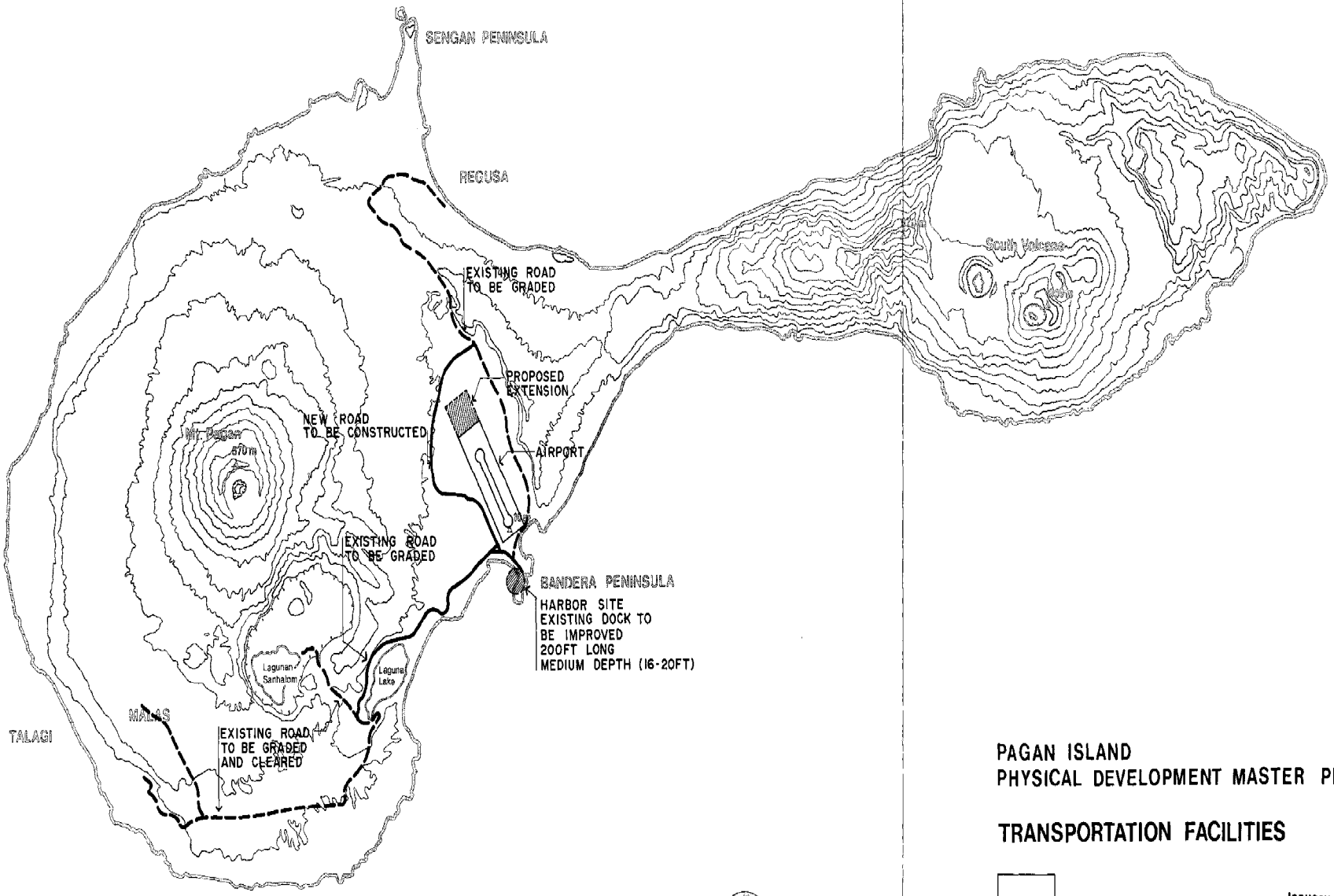
Presently, Pagan is served only by special charter flights. These air taxi operations, which presently fly out of Saipan, use small twin-engine Cessnas or similar aircraft. These aircrafts can be accommodated with a minimum 3000-foot long runway under the Basic Utility, Stage II, airport criteria, in accordance with FAA policy.

PROPOSED AIRPORT IMPROVEMENTS

Pagan Airport, at present, is not on the NASP (National Airspace System Plan) list and its chances, at the present time of getting on the list is minimal at best. Therefore, development of this airport is, at present, not eligible for ADAP funds. It is recommended that a minimum austere airport be initially developed at Pagan to encourage regular scheduled flights.

* Site preparation including clearing for obstruction removal at approach and transitional surfaces; grading and recompaction of the 3,000-foot long runway, taxiway and apron; and installation of wind cone/segmented circle. Estimated cost for these improvements is $200,000.

The proposed improvements should be funded through either the Marianas Islands Airport Authority which has responsibility for the operations and maintenance of the existing airport, or through Economic Development Authority funds. Initial siting and preparation of the airfield should be such that the runway could be expanded to 4,000 feet (see Plate 7).



PAGAN ISLAND
PHYSICAL DEVELOPMENT MASTER PLAN

TRANSPORTATION FACILITIES

7

January 1978

Pacific Planning and Design Consultants

Saipan · Commonwealth of the Northern Mariana Islands

HARBOR

The existing dock was constructed by the Japanese prior to World War II. Today, it is in a state of disrepair. Several of the concrete blocks have been toppled and rubble lies along side the dock making it impossible for vessels (other than shallow draft) to land there. Presently the field trip vessels anchor in the deeper parts of the Shomushon Harbor and lighter goods ashore.

It is anticipated that during the plan period the frequency of field trip vessels to the Northern Islands will increase to as many as twelve (12) trips per year. It is doubtful that even this increase can justify the expenditure of funds necessary to reconstruct the existing facility. Estimated cost to reconstruct 200 feet of medium depth pier is $600,000. Much of this cost being attributed to the expense of mobilization (see Plate 7).

During recent field investigations only three boats were observed all less than 20 feet in length. These are reportedly used frequently for fishing as a regular source of food. The need for a new dependable boat is apparent, and it is recommended that a small, twin diesel craft in the 20 to 25 foot range be purchased for village use. Anchorage is available in a small arcuate shaped harbor south of Bandera Peninsula; however, during tropical storms and typhoons it will be necessary to secure the vessel on land. Funds have been allocated in the 1978 Capital Improvement Program ($30,000) for the purpose of purchasing a small boat and transporting the vessel to Pagan.

RECOMMENDATIONS

The expense of repairing the existing dock facility suggests that reconstruction should be delayed until such time as federal assistance becomes available or a total development plan is put

forward in conjunction with either basalt excavation, increased tourism, or a similar economic activity requiring improved harbor facilities.

During the interim period it is suggested that the entire Bandera Peninsula be reserved for harbor and commercial activities and that this land be excluded from any homesteading lands.

ROADS

Most of the roads existing today on Pagan were built by the Japanese. The roads were constructed as one lane lose-surface graded all weather roads, however, lack of maintenance since 1973 has resulted in most becoming gulley and rut filled. Today many are impossible or have deteriorated to trails.

The existing motorized vehicle population on Pagan consists of two jeeps, a tractor, and a motorcycle. Most transportation continues to be provided by bull-cart.

There is a need to improve the road from Bandera to Regusa and also the road northward to Laguna Lake, Malas and Talagi if the remaining copra industry is to be encouraged. There will also be a need to improve access to and from the harbor and within the Village Homestead area (see Plate 7).

RECOMMENDATIONS

Road improvements during the plan period should consist of grading and compacting of the existing system. Only minimal drainage improvements and realignment should be considered.

It will be necessary for equipment and crews to be sent up from Saipan to accomplish this work. It is suggested that all work be accomplished in conjunction with any airport or harbor improvements that might take place during the plan period. Costs of these improvements should be borne by the proposed funds for Village and Agricultural Homestead program and from general operations and maintenance funds.